PROBLEMS.

22. **Proposed by DE VOLSON WOOD, C. E., Professor of Mechanical and Electrical Engineering in Stevens Institute of Technology, Hoboken, New Jersey.**

A prismatic bar having a uniform angular velocity ω and a linear velocity of v feet per second, suddenly snaps (by the disappearance of the cohesive force) into an indefinite number of equal parts; required the resultant angular velocity of each piece and the locus of the parts at the end of t seconds after rupture.

23. **Proposed by ALFRED HUME, C. E., D. Sc., Professor of Mathematics, University of Mississippi, University Post Office., Mississippi.**

A heavy particle is placed upon the surface $\sqrt{x}+\sqrt{y}+\sqrt{z}=c$. The axis of z being vertical and the coefficient of friction being $\sqrt{2}$, show that a point of equilibrium (all friction possible being brought into action) z is a harmonical mean between x and y.

MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

13. **Proposed by CHARLES E. MYERS, Canton, Ohio.**

A soap bubble 2 inches in diameter, is filled with one part of hydrogen gas and 15 parts of air. If the bubble just floats in the air, find the thickness of the film.

I. **Solution by H. C. WHITAKER, B. S., M. E., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.**

Take, as the unit of weight, the weight of air filling a sphere of one inch radius, then the weight of a corresponding volume of hydrogen is .06927 and of a corresponding volume of water is 792.24. Take x=inner radius of sphere. The weight of the hydrogen is $\frac{.06927}{16}x^3$;

The weight of the air in the bubble is $\frac{15}{16}x^3$;

The weight of the water is $792.24(1-x^3)$;

The weight of the air displaced is 1.

Making the sum of the first three of these equal to the last and solving, $x=.999977$, and the required thickness is .000023 inches.

II. Solution by G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

In solving this problem many things should be considered. We should know the temperature, the barometric pressure and the dew point in order to calculate the amount of aqueous vapor present in the air.

Not knowing the above it will be well to proceed as follows:

Let r=outside radius of bubble, x=inside radius.

ρ=density of air, ρ_1=density of hydrogen, ρ_2=density of soap film, — all at the given temperature and pressure and all referred to normal air as standard.

$$\text{Then } \tfrac{4}{3}\pi(r^3-x^3)=\text{volume of soap film},$$

$$\tfrac{4}{3}\pi\times\frac{x^3}{16}=\text{volume of hydrogen},$$

$$\tfrac{4}{3}\pi\times\frac{15x^3}{16}=\text{volume of air}.$$

$$\therefore\quad \tfrac{4}{3}\pi(r^3-x^3)\rho_2+-\tfrac{4}{3}\pi\times\frac{x^3}{16}\rho_1+\tfrac{4}{3}\pi\times\frac{15x^3}{16}\rho=\tfrac{4}{3}\pi r^3\rho,$$

$$\therefore\quad 16r^3\rho_2-16x^3\rho_2+x^3\rho_1+15c^3\rho=16r^3\rho,$$

$$\therefore\quad x^3=\frac{16r^3(\rho_2-\rho)}{16\rho_2-15\rho-\rho_1},\quad \therefore\quad x=2r\sqrt[3]{\left(\frac{2(\rho_2-\rho)}{16\rho_2-15\rho-\rho_1}\right)}.$$

$$r-x=r-2r\sqrt[3]{\left(\frac{2(\rho_2-\rho)}{16\rho_2-15\rho-\rho_1}\right)}=\text{required thickness}.$$

Let the conditions be normal and suppose ρ_2, referred to water, is 1.1. Then since air, referred to water, is .001293, ρ_2, referred to air, is 850 73473, $\rho=1$, $\rho_1=.0693$, $r=1$.

$$\text{Then } r-x=1-2\sqrt[3]{\left(\tfrac{1199.46946}{13596.68638}\right)}=.000023.$$

Also solved by *P. S. Berg*, *F. P. Matz*, and the *Proposer*.

14. Proposed by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tennessee.

I have a glass paper-weight in the form of a regular icosahedron. I let the sun's rays fall upon it, at various angles, also upon one of the vertices. How many complete spectra will be formed? How many will be of white light? What position will give maximum number of spectra?

[No solution to this problem has as yet been furnished by our contributors, and I see no way of solving it. If a solution is possible it will be a very pretty one. —EDITOR.]

PROBLEMS.

22. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

From what kind of dry wood must a ship's log be cut, in order that the log may float with its center of gravity at the water's surface?